PATENT SPECIFICATION

DRAWINGS ATTACHED

906,002

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Improvements in or relating to power transmission devices for friction type change speed gearing arrangements.

COMPLETE SPECIFICATION

We, SOCIETE DES FABRICATIONS UNICUM, a French Limited Company of 22 Rue Tiblier Verne, Saint-Etienne, Loire, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to power transmission devices for compensating for variations in the resistance torque relative to the driving torque in friction-type change-speed gearing arrangements.

Reference will now be made to Figures 1 and 2 of the accompanying drawings in which:

Figure 1 is a diagrammatic side elevational view partly in section, of a known friction-type change-speed gear arrangement, and

Figure 2 is a similar view of part of such an arrangement.

1 designates a driving shaft to which a driving torque can be applied. The shaft 1 is arranged to drive via a gear train comprising gear wheels 2 and 3, a plane wheel 4. The shaft 1 may also be arranged to drive a further plane wheel 4^1 (shown in broken lines) via a gear train comprising the gear wheels 2, and 3^1 (shown in broken lines). A roller 5 is subjected to pressure between the wheel 4 and a driven wheel 6 so that the wheel 6 is driven by the wheel 4 through the roller 5. Where a further plane wheel 4^1 is employed a further roller 5^1 (shown in broken lines) is arranged between the wheel 4^1 and the driven wheel 6, so that the wheel 6 is also driven by the wheel 4^1, as well as the wheel 4. An output shaft 7 is arranged to be driven by the wheel 6 via a power transmission device, which will be hereinafter described. The power transmission line from the driving shaft 1 to the output shaft 7 is indicated by broken lines.

It is known that while torque usually varies inversely with speed, so that high torque usually occurs at low speeds and *vice versa*, these conditions are dependent on the resistance torque. The driving torque is transmitted from rollers 5, 5^1 to the output shaft 7 by a pressure transmission device which applies a pressure between a driving member 9 and a driven member 10 and between rollers 5, 5^1 and the driving member 9 so that the drive is adapted to compensate for variations in the magnitude of the resistance torque of the output shaft with respect to the driving torque applied to said shaft. The above mentioned transmission device is arranged as follows:—

The driven or pressure member 10 which is rotatable with the output shaft 7 is urged by a spring 8, axially of the shaft 7 so as to bear against the member 9 fixedly attached to the wheel 6. The abutting faces of the members 9 and 10 each have two pairs of opposed ramps 9^1, 9^2 and 10^1, 10^2 respectively. Each of these ramps corresponds to a portion of the surface of the thread of a square section screw thread over one quarter of the pitch of the thread. In accordance with the direction of the relative circumferential displacement of the members 9 and 10, two of the ramps of each member are, during operation of the device, always in contact over a considerable portion of their surfaces. Alternatively the corresponding ramp surfaces of the members 9 and 10 may be formed with concave recesses cooperating to accommodate bearing balls displaceable in accordance with the direction of the relative circumferential displacement of the members 9 and 10, axial pressure being developed as the balls are displaced. Between each of the balls and each of the members 9 and 10, however, there is a single point of contact which runs along a line in the form of a sector of a circle during relative circumferential displacement of the member. The above ball bearing arrangement is not shown in the drawings. The above described transmission

devices are all of somewhat complicated construction, and consist of a plurality of parts. Although such transmission devices in which balls are disposed between the members can transmit torque variations sensitively, owing to the effect of such variations upon a single line of balls in the recesses in the members 9 and 10, depressions may be formed in the recesses whereby the balls are no longer displaceable in the recesses so that the device becomes inoperable. In known devices in which the ramps bar against one another, the ramps have merely a slight angle of slope so that they are sensitive to follow small variations of the resistance torque relating to the driving torque and vary the pressure between the driving member 9 and the driven member 10 in order to compensate for these variations. When the variations of the resistance torque become excessive, the ramps do not follow all these variations for they become locked or jammed together and a slight reverse torque is not able to overcome this jamming. The slope, therefore, must be sufficiently steep for the circumferential relative displacement of the members 9 and 10 to be reversible. If, however, the slope is too steep the variations in axial thrust are poor, particularly at high speeds, and do not follow all the variations of the resistance torque. In Figures 1 and 2, the direction and magnitude of the forces exerted are indicated by arrows.

When ramps 9^1-9^2 and 10^1-10^2 have a slight angle of slope, as is generally the case having regard to the limit within which reversibility of the circumferential displacement of the members is possible, good axial pressures are obtained at high speeds whereas at low speeds there is excessive thrust, and in any event when the slope has a slight angle the said reversibility is poor for all speeds.

A further disadvantage of the above described devices is that when axial pressure is exerted on the wheel 6 and roller(s) owing to the arrangement of the ramps of the members 9 and 10, such axial pressure neutralises, by reaction in the opposite sense, the thrust of the spring 8. The spring 8 is interposed between the end of the bore in the shaft 7 and the member 10. Figure 2 shows that, where there is a considerable variation in the resistance torque, the axial pressure resulting from the force at the ramps 9^1-9^2 and 10^1-10^2 is transmitted not only in the direction of the wheel 6 and the roller(s) but by reaction in the opposite direction as well, that is to say in the direction of the arrow R, Figure 2. The force or thrust F of the spring 8 is diminished and is in some cases even cancelled out. This is undesirable, since the maximum pressure should be in the direction of the wheel 6 and the roller(s) regardless of the speed of rotation of the device and of the variation in the resistance torque.

According to the present invention there is provided a power transmission device for compensating for variations in the resistance torque relative to the driving torque in a friction-type change-speed gear arrangement having an output shaft, wherein a first pressure member co-axial with the output shaft is mounted for rotation by a friction roller which is arranged to be rotatably driven by driving torque applied to said arrangement, the first pressure member being displaceable with respect to the output shaft in the direction of the axis of rotation of the first member and having a plane surface transverse to said axis and co-operating with said roller, there being a second pressure member arranged to rotate said output shaft, the second member being movable axially of the output shaft but fast in rotation therewith, an abutment face on said first member being engageable with a complemental abutment face on said second member so as to connect said first member to said second member in driving relationship therewith, a device associated with the output shaft being provided for moving the second member towards the first member to take up axial play between the abutment faces of these members, said abutment faces being such as co-operate so as to develop a pressure which urges said first member from said second member when said first member is rotated whereby said surface is forced against said roller, there being spring means having one end acting against an abutment of said output shaft and the other end acting on the first member so as to exert on said first member a continuous thrust which urges said surface against said friction roller for supplementing said pressure.

For a better understanding of the present invention and to show how the same may be carried into effect reference will now be made to Figures 3 to 8 of the accompanying drawings, in which like designations indicate parts having a similar function, and in which

Figure 3 is a diagrammatic side elevational view, partly in section of a part of a friction-type change-speed gear arrangement rotating at high speed, the corresponding pressure and thrust being indicated by arrows,

Figure 4 is a similar view of the device shown in Figure 3 rotating at low speed, the corresponding pressure and thrust being indicated by arrows,

Figure 5 and 6 is each a perspective view of a detail of the device shown in Figures 3 and 4, drawn to a larger scale than that employed in Figures 3 and 4, and

Figure 7 and 8 is each a side elevational view, partly in section of part of a practical constructional example of a friction-type

change-speed gearing arrangement.

Reference will now be made to Figures 3 and 4 of the accompanying drawings.

Resilient means for applying continuous thrust, which in the embodiment shown in the above Figures is a coil spring 11 having a large cross section, is mounted coxially with the shaft 12^1 of a pressure member 12, so as to be somewhat compressed, between a bearing member 7^1 mounted in the bore of an output shaft 7, and the base 12^2 of the pressure member 12 connected to a driven wheel 6 drivable by means of rollers 5 and 5^1. Alternatively the spring 11 could be arranged so as to bear directly against the wheel 6, the base 12^2 being omitted. A ball type thrust bearing 13 is interposed between the spring 11 and the base 12^2 so as to allow a slight circumferential displacement between the spring 11 and the member 12. The shaft 12^1 of the member 12 is provided with two pairs of contact ramps 12^3, 12^4, rearwardly of the bearing member 7^1, which member is adapted to guide and support the shaft 12^1. The ramps 12^3 and 12^4 are arranged to cooperate with corresponding pairs of ramps 14^1, 14^2, on a second pressure member 14, which is mounted in a bore of the shaft 7. Each ramp of each member is equivalent to a quarter of the pitch of a screw thread of square cross-section and coarse pitch. The ramps 14^1 and 14^2 form an abutment face on the member 14 which it will be seen from Figures 3 and 4, is complemental to the abutment face on the member 12 formed by the ramps 12^3, 12^4. The member 14 is arranged to be rotatable with the shaft 7 by means of keys 14^3. Means other than the keys 14^3 may be employed for connecting the member 14 to the shaft 7. The member 14 is arrested in known manner in the direction of the end of the bore, by an abutment 15 of a device for automatically taking up play. The ramps 12^3, 12^4 and 14^1, 14^2 are steeply inclined, so that the circumferential displacement of the members 12 and 14 relative to one another is readily reversible. This arrangement of the ramps and of the mounting of spring element 11 affords considerable sensitivity to variation in resistance torque for average and low speed of rotation of the arrangement.

Since the thrust of the spring 11 is exerted entirely in the direction of the wheel 6 and rollers 5 and 5^1, the arrangement remains sensitive even when operated at high speed. The direction and magnitude of the thrust and the pressure exerted at high speed are indicated by arrows in Figure 3 from which it can be seen that the thrust of the spring 11 is additive to the pressure due to the reaction of the ramps 12^3, 12^4, and 14^1, 14^2, even where the last mentioned pressure is very slight so that a total pressure of a desirably high value is therefore provided between the wheel 6 and rollers 5, 5^1. The magnitudes and direction of the thrust and the pressure obtaining at average and low speed are indicated in Figure 4 by arrows from which it can be seen that at average and low speed the thrust of the spring 11 supplements the pressure due to the reaction of the ramps 12^3, 12^4, and 14^1, 14^2, which latter pressure is considerable under such speed conditions. The pressure due to the reaction of the ramps and between the rollers 5, 5^1 and the wheel 6 is greater at low and average speed than at high speed since, dependent upon the resistance torque, usually varies inversely with speed so that this pressure is greater at average and low speeds than at high speed. The thrust from spring 11 always supplements this pressure so that the total pressure is greater at higher speed than the pressure at high speed in the arrangement shown in Figures 1 and 2. Also, the spring 11 is smaller in diameter in the embodiment shown in Figures 3 and 4 than in the known arrangement shown in Figures 1 and 2. In the embodiment shown in Figures 3 and 4, ramp type, instead of ball type, pressure surfaces on the abutting members can be used at all working speeds of the transmission device.

A practical constructional example of an embodiment of a transmission device is shown in Figure 7. In this embodiment two rollers 5 and 5^1 are employed for driving a plane wheel 6. The parts of the gear arrangement which correspond to the parts shown in Figures 3 to 6 have the same designations as those parts. A needle roller bearing 16 is mounted in a bearing member 7^1 which is keyed in the bore of an output shaft 7. The purpose of the bearing 16 is to render a pressure member 12 freely displaceable circumferentially relative to a second pressure member 14. A ball type thrust bearing 13 is also provided for this purpose. An abutment 15 is provided for the same purpose as the abutment 15 shown in Figures 3 and 4.

A further practical constructional example of an embodiment is shown in Figure 8. The wheel 6 being drivable by a single roller 5. This embodiment operates in the same manner as that shown in Figure 7 and differs from the embodiment shown in Figure 7 merely in constructional detail. In all the aforementioned embodiments balls carried in recesses in the ramps of the pressure members, can be employed instead of direct contact ramps.

The above mentioned embodiments may be modified in various ways within the scope of the appended claims.

WHAT WE CLAIM IS:—

1. A power transmission device for compensating for variations in the resistanee

torque relative to the driving torque in a friction-type change-speed gear arrangement having an output shaft, wherein a first pressure member co-axial with the output shaft is mounted for rotation by a friction roller which is arranged to be rotatably driven by driving torque applied to said arrangement, the first pressure member being displaceable with respect to the output shaft in the direction of the axis of rotation of the first member and having a plane surface transverse to said axis and co-operating with said roller, there being a second pressure member arranged to rotate said output, shaft, the second member being movable axially of the output shaft but fast in rotation therewith, an abutment face on said first member being engageable with a complemental abutment face on said second member so as to connect said first member to said second member in driving relationship therewith, a device associated with the output shaft being provided for moving the second member towards the first member to take up axial play between the abutment faces of these members, said abutment faces being such as to co-operate so as to develop a pressure which urges said first member from said second member when said first member is rotated whereby said surface is forced against said roller, there being spring means having one end acting against an abutment of said output shaft and the other end acting on the first member so as to exert on said first member a continuous thrust which urges said surface against said friction roller for supplementing said pressure.

2. A device as claimed in claim 1, wherein said abutment faces are formed by inclined surfaces of ramps arranged on said pressure members.

3. A device as claimed in claim 2, wherein said inclined surfaces are steeply inclined.

4. A device as claimed in claim 2 or 3, wherein in the case of each pressure member said ramps are in plan view arc shaped, and are arranged in similar pairs, the ramps of each pair being similar and opposed, all the ramps of each member cooperating to form a circular collar coaxial with the axis of rotation of said member.

5. A device as claimed in claim 4, wherein in the case of each member the ramps are four in number, each ramp being equivalent to a quarter of the pitch of a screw thread of square cross-section and coarse pitch.

6. A device as claimed in any one of the preceding claims, wherein said spring means comprises at least one helical spring disposed between a bearing member for rotatably carrying said first pressure member, which bearing member is mounted in a bore in said shaft, and a base plate for the first pressure member, said plate being attached to or integrally formed with the non-driven surface of said wheel, said spring being directed axially of said shaft and exerting a continuous pressure on said bearing member and said plate.

7. A device as claimed in claim 6, wherein said base plate is rotatably supported in said bore.

8. A device as claimed in claim 6 or 7, wherein a ball type thrust bearing is interposed between the said spring and said base plate.

9. A device as claimed in any one of the preceding claims, wherein each pressure member is cylindrical, an end face of the cylinder being formed as the abutment face in the case of each pressure member.

10. A device as claimed in any one of the preceding claims, with the modification that balls are interposed between the two abutment faces.

11. Power transmission devices for compensating for variations in the resistance torque relative to the driving torque in a friction-type change-speed gear arrangement, substantially as hereinbefore described with reference to Figures 3 to 6, Figure 7 or Figure 8 of the accompanying drawings.

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906,002 COMPLETE SPECIFICATION
3 SHEETS
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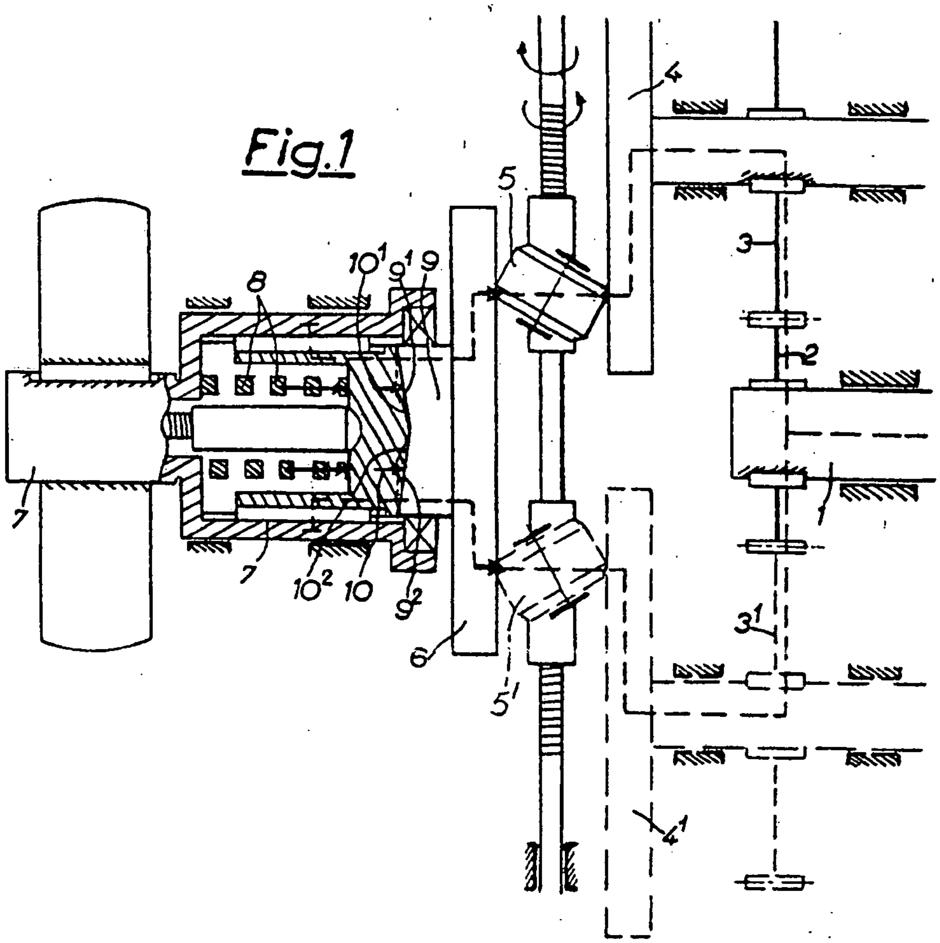
SHEET 1

Fig.1



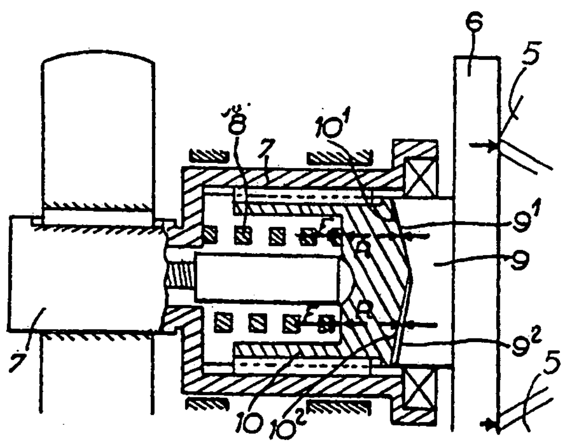
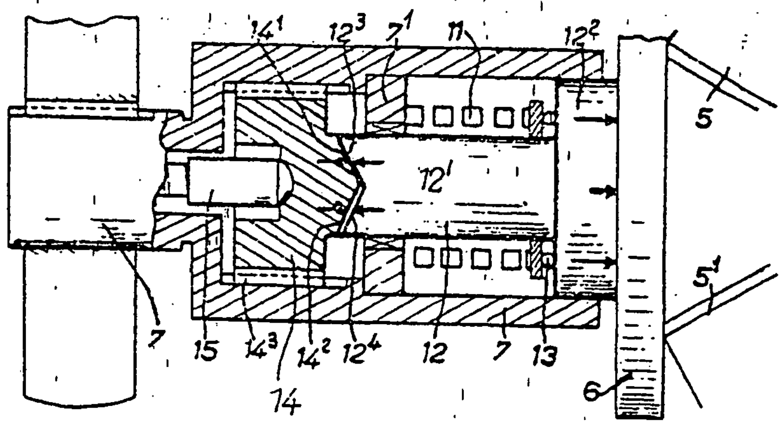


Fig.2

Fig.3



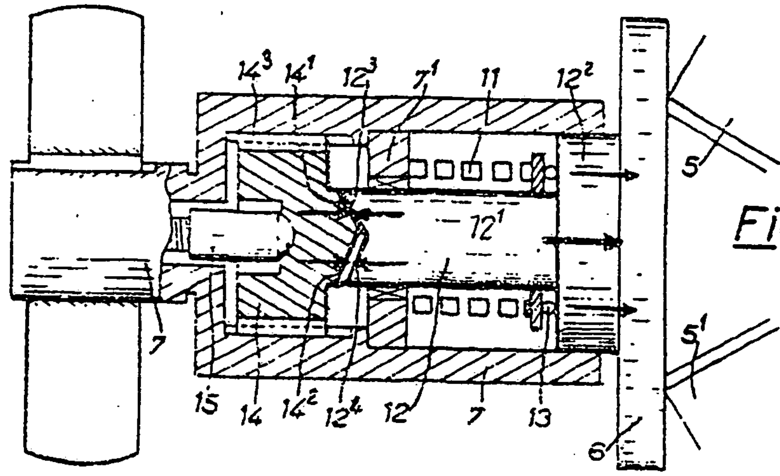


Fig.4

Fig.5

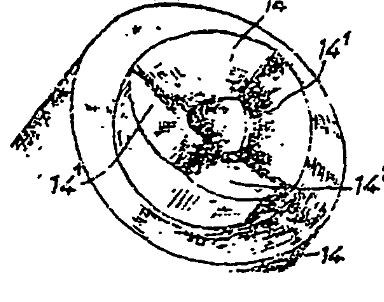
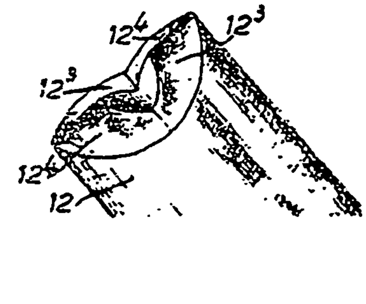


Fig.6



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906,002 COMPLETE SPECIFICATION
3 SHEETS

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SHEETS 2 & 3

Fig.7

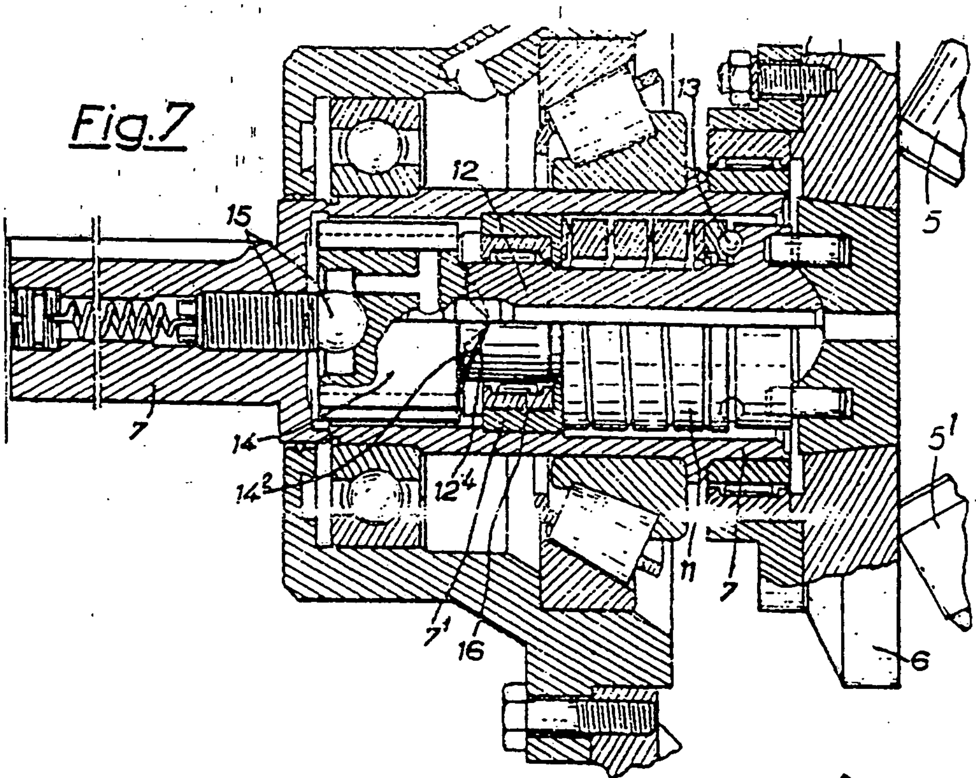

Fig.8

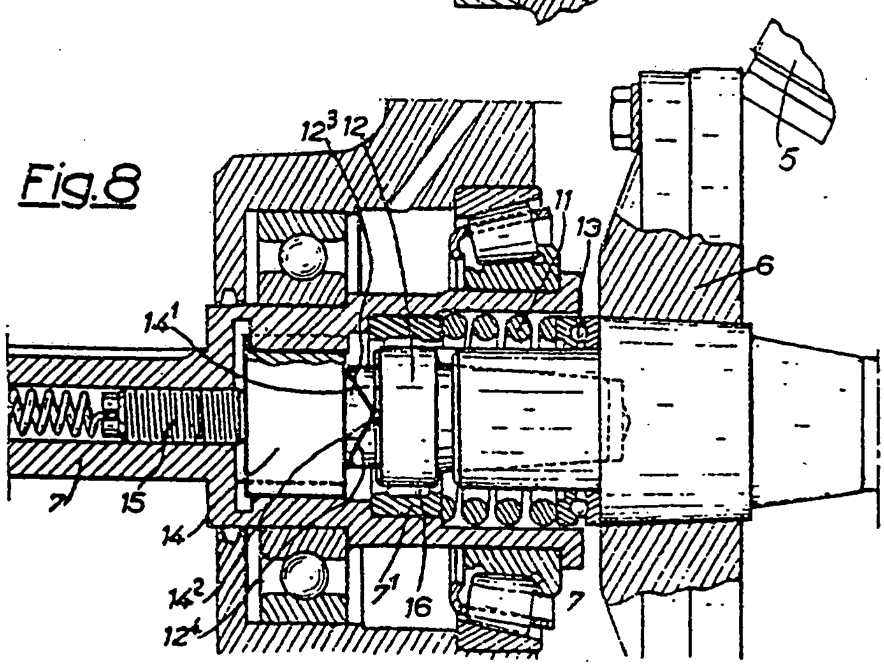

Fig.3

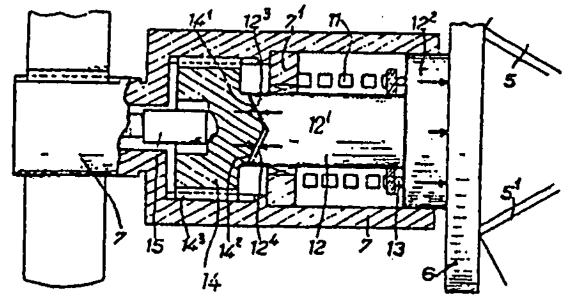

Fig.4

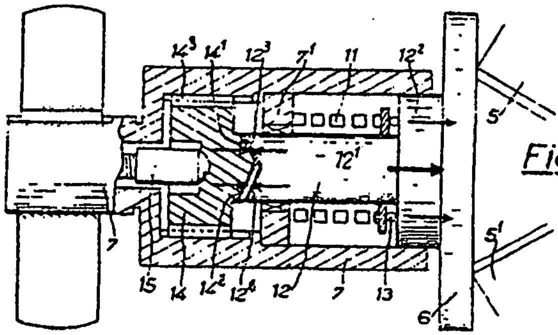

Fig.5

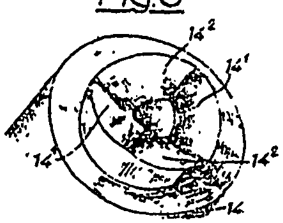

Fig.6

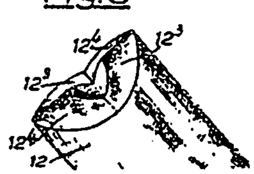

Fig.7

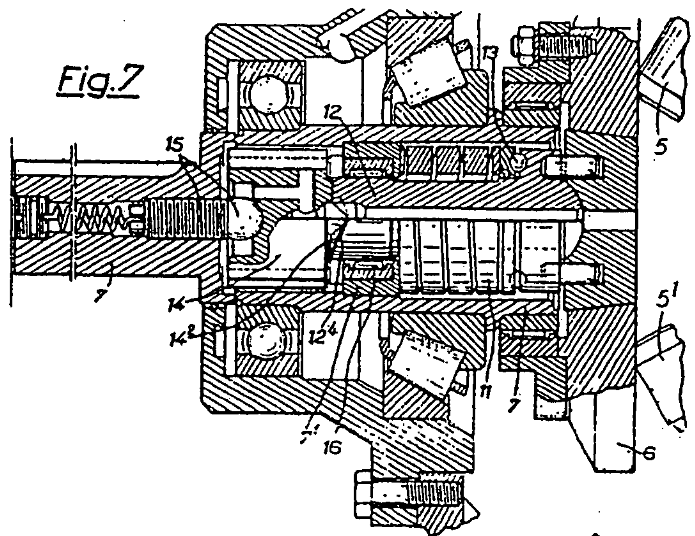

Fig.8